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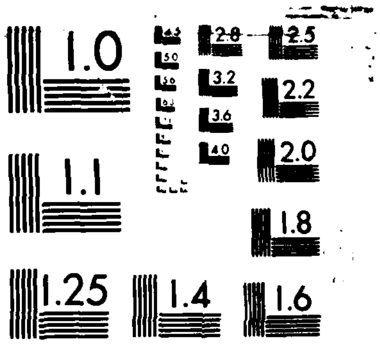

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Report for:
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Validation of MODES

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Report by:
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1.0 MODES DESIGN REQUIREMENTS.

Central to any validation of MODES are the principal requirements under which it was designed and constructed:

(1) MODES should support crisis action deployment planning.

(2) MODES should aid in the very early part of the crisis action planning process.

(3) MODES should provide useful information in two to four hours.

(4) MODES should address questions concerning "gross transportation feasibility" among alternative courses of action.

A comprehensive understanding of these design criteria is essential in developing a reasonable validation process.

1.1 Supporting Crisis Action Planning

The operative terms here are "support" and "crisis action". MODES was not designed to replace the Supported Commander and his staff. It was intended as a tool for enhancing their capabilities. As a result MODES should be evaluated with planners, not against them.

MODES is not a deliberate planning tool. It was not designed to accomodate the level of detail which is possible in a deliberate planning cycle. It was designed to aid in making rapid go/nogo decisions at the first level in a hierarchical planning system. At its level of use, it should help establish attainable EADs, LADs, and RDDs as well as provide recommendations on channel size, on mode, and on general routing for movement requirements. It should also provides gross feasiblity assessments with regard to closure. MODES was not designed to provide the detail scheduling information currently generated in the deliberate planning process. The output of MODES should be viewed as one of the inputs to the detailed scheduling process.

1.2 Initial Planning Capability

MODES was designed to provide initial planning capability to the Supported Commander and his staff in the very early stages of the crisis action planning process. As a result, MODES must be prepared to work with a variety of levels and quality of data in providing information on various courses of action.

1.3 Rapid Turnaround

One of the strongest design criteria for MODES was that it must provide information on reasonable sized courses of action in two to four hours. This criteria had the single greatest effect on the final design for MODES.

1.4 Gross Measures of Transportation Feasibility

MODES was designed to provide estimates of gross transportation feasibility to the Supported Commander. Once MODES provides gross feasibility estimates, at least two more levels of analyses are required to generate the detailed schedules and corresponding detailed closure estimates required by the TOAs. Models to support these additional levels of analysis are currently being actively developed by the TOAs.

2.0 A STRUCTURE FOR MODES VALIDATION

With the MODES design criteria in mind, we believe that a reasonable MODES validation process should try to answer the following three questions:

(1) Are the MODES recommendations reasonable?

(2) What MODES resolution is practical in reasonable response time?

(3) What is the quality of the MODES recommendations?

Each of these questions and associated analyses will be discussed in turn.

2.1 Reasonability Analysis

Reasonability analysis deals with the ability of MODES to provide results which describe reasonable outputs for given inputs. In a sense, this is an intermediate step between verification analysis and final validation.

2.1.1 Extremal Analysis

In testing a procedure for reasonableness it is generally easier to test the extremes before testing mid-range results. In an extremal analysis of MODES, a number (ten to twenty) of scenarios should be described with the parameters fixed so that the only reasonable MODES outputs are readily predicted by analysts. Examples include small scenarios

with fixed ports, fixed channels, and/or limited assets.

Each resulting MODES output should then be evaluated by knowledgeable planners for reasonableness of response to the constraining input conditions. Each evaluation would be rated "pass" or "fail". Failures would be accompanied by an explanation of the difficulty. Each failure or difficulty would be reviewed by MODES designers for possible explanation or subsequent MODES modification and adjustment.

Extremal analyses test the boundaries of MODES responses to assure valid results in extraordinary situations.

2.1.2 Parametric Analysis

The next step in a reasonability analysis is to evaluate MODES responses to variations in parameters. In this analysis, more involved scenarios should be tested wherein MODES results are not so obviously predictable. The output should be evaluated by a team of planners. The team would attempt to rationalize the MODES output or to point out inadequacies in the logic.

In this analysis the MODES parameters would be varied over a range of values. The objective is to test sensitivity of parameter values to MODES output responses. (This also serves as a "tuning" of the MODES system.) Each report (by the test team) would contain an analysis of the robustness of the MODES model to help define rational responses to varying threats.

2.1.3 Feasibility Analysis

This analysis would help answer the question of "what is reasonable MODES resolution?"

This analysis is accomplished by first applying MODES to a set of test scenarios and then using the MODES output as input to the detailed scheduling process. The detailed scheduling could then either be performed manually or for larger scenarios with the aid of TFE or the TOA scheduling models. The detailed schedules and corresponding detailed closure estimates should then be compared with the output of MODES to determine overall consistency. Note that this is not the same as comparing MODES generated results with simulation generated results. Such a comparison would be meaningless since the models do not utilize the same levels of detail and the simulation models themselves have never been validated. The test described here would test whether given levels of resolution are consistent with simulation models in reporting port/asset loadings and closure estimates.

This testing sequence would be repeated for varying resolution of the MODES model (ports, assets, time). A panel of planners would evaluate MODES output with the resulting simulation results and submit a report comparing and contrasting the results. The idea here is not to charge MODES with the responsibility of tracking simulation results, but to use simulation results as a means for experienced planners to assess relative precision of results. This will provide experienced planners with a framework for making reasonable judgements of desired resolution. It will also indicate whether the input parameters for MODES need to be factored to account for the loss of detail in the data. For example, it may be desirable to have MODES work under the assumption that less than one hundred percent of the capability of a channel is actually usable.

3.0 RESPONSE TIME ANALYSIS

In this series of analyses various sizes of problems are input to the MODES model for solution. By varying numbers of ports, asset types, movement requirements, and aggregation levels, and charting the resulting solution times for the MODES model, an understanding of the response time of the MODES model under varying problem conditions will be obtained.

3.1 Parameter Selection

Not all parameters affect the MODES model in the same manner. Adding asset categories increases the LIFTCAP problem only slightly, while leaving the size of the MRMATE problem unchanged. Adding ports increases the LIFTCAP problem to a greater extent and the MRMATE problem moderately. Adding movement requirements adds only to the MRMATE problem.

The LIFTCAP problem generaly requires much less time to solve than the MRMATE problem. Therefore any parameter change which significantly affect the size of the MRMATE problem will generally result in longer solution times.

3.2 Aggregation Level

The single most significant determinant of problem running time is aggregation level. A slight change in aggregation level of almost any of the variables can cause the MRMATE problem to change considerably in size and produce unacceptable solution times.

3.3 Predicting Problem Size

It is possible to predict problem size given input numbers of ports, asset categories, time periods, and movement requirements. Georgia Tech PDRC Report 84-09 gave a series of formulas to predict LIFTCAP and MRMATE problem size given input data. These formulas should be helpful in judging scenario size for testing responsiveness of the MODES model.

4.0 QUALITY ANALYSIS

Once the limits of the MODES model have been determined and its resolution and robustness evaluated, the final test of its quality and usefulness can be made. This series of tests should evaluate the MODES model in planning situations pitted against currently available planning tools.

4.1 Control Groups

The only reasonable test of MODES is in its ablitiy to support crisis action planning in the first two to four hours. Therefore, tests must be developed to evaluate this capability. One such method would employ control groups. Teams of experienced planners would be divided into two groups and given the same scenerio to evaluate in a two to four hour time limit. One group would be permitted to use MODES while the other (the control group) would not. A number of scenarios should be evaluated with each group having a opportunity to become the control group (thus minimizing group bias). Also, if time permits the groups should be reconfigured to minimize any possibility of individual bias.

4.2 Scenario Planning

The MODES group and the control group should both be presented with identical scenarios simulating a crisis action planning situation. A time limit of two to four hours should be given. Both groups may use any technique available, except that the MODES group must also use MODES and the control group may not use MODES. At the end of the alloted time both groups must provide a recommendation and supporting analyses.

This testing technique should be repeated for several scenarios of varing size and complexity. In some cases even though both groups must hand in their recommendations after the alloted time, they may continue planning for some longer time specified in the analysis. A second set of recommendations would be provided by each group at the end

of the new time limit. This would give an indication of the value of MODES when time is not as critical and would indicate the potential for using MODES in the deliberate planning process.

4.3 Plan Evaluation

For each scenario, boths sets of plans (MODES and control) should be evaluated by a third panel of experienced planners. The panel would assess the relative quality of the two plans. The panel would not be time constrained and could use any technique are analysis available to them to draw their conclusions.

The panel would be required to put the two recomendations on a ordinal scale (indicating which is better) or on a cardinal scale (indicating how much better one is over the other). An example of a simple cardinal scale is "superior, better, equal."

The panel should also provide a written assessment of the two recommendations and supporting analyses.

4.4 MODES Quality Assessment

Panel results would be charted, and these together with the written evaluations provide a basis for a validation of MODES. Some group must evaluate the panel results and results of the earlier studies to write a report on the validation of the MODES model. In the final analysis the resulting judgements will be subjective, but this subjectivity will be minimized by the intermediate reports and panel evaluations.

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